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(54) **Dishwashing machine having a natural ventilation drying system**

(57) A dishwashing machine (1) is described, of the type comprising a washing chamber (2) within which the dishes are contained, contained in one or more baskets. The dishwashing machine according to the invention is equipped with a natural air circulation system in the washing chamber (2), with the aims of favouring the elimination of the steam and the drying of the dishes. The system comprises in particular two mouths (5,10) that place in communication the interior of the chamber

(2) with the external environment; the first mouth (10), which functions as an entrance for the air flow (16), is realised in the lower zone of the chamber (2), while the second mouth (5), which functions as the exit for the air-steam mixture, is realised in the upper zone of the chamber (2). The structure of the two mouths (10,5) is realised so as that they offer appropriate resistance to the incoming and exiting flows, in such a way as to optimise the air recirculation capacity.

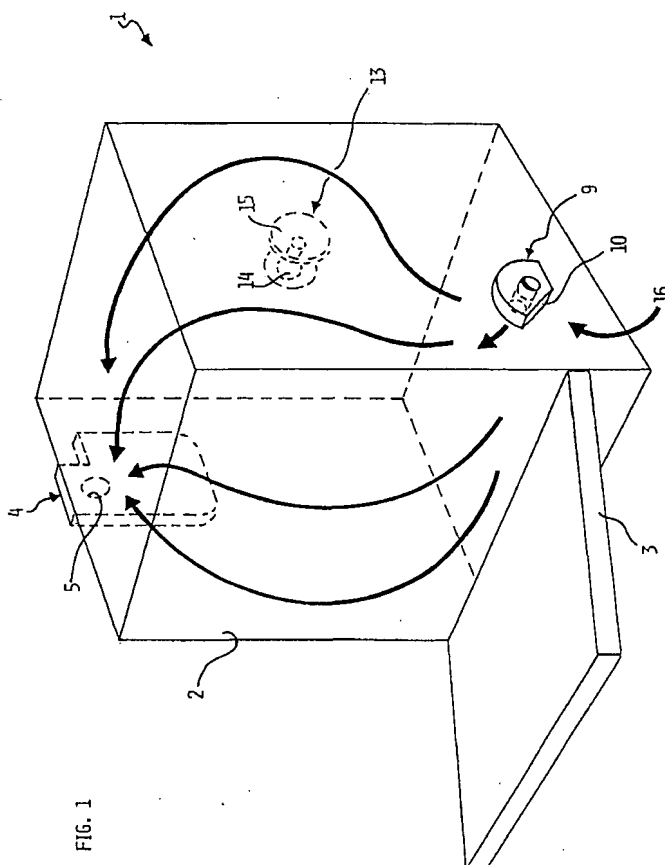


FIG. 1

## Description

The present invention relates to a dishwashing machine having a drying system, as specified in the preamble of the first claim.

It is known that, upon termination of a washing cycle, domestic dishwashing machines should provide a phase for drying the dishes and for eliminating the steam present within the washing chamber.

In the more traditional solutions, the elimination of the steam from the chamber and the dampness from the dishes is obtained by leaving such dishes in the machine, for a given length of time, during which the steam is substantially eliminated due to a "condensing effect" carried out by the walls of the chamber, and also allowing that a minimum amount of the steam penetrates a multifunction device where it can condense.

The results of this type of drying has often shown itself to be unsatisfactory, for instance because the steam, remaining in the chamber for a given length of time, tends to re-condense on the dishes.

With some known dishwashing machines a dedicated fan is provided, able to cause a circulation of the air within the washing chamber, in such a way so as to realise a final forced drying phase of the dishes and pans.

Such system, which allows for obtaining better drying results compared to the more traditional technique, does however have the drawback of requiring expensive components, such as the dedicated fan and the relative control circuit; a further drawback of the mentioned solution is that constituted by a certain bulk of the fan, which results in being difficult to house within the slight space available within the cabinet or door of the dishwashing machine. The aim of the present invention is that of overcoming the aforementioned drawbacks, by way of indicating a dishwashing machine equipped with a drying circuit that is of effective functionality, of simple realisation, compact and of contained costs.

Such aims are reached according to the present invention by way of a dishwashing machine incorporating the characteristics of the annexed claims.

Further characteristics and advantages of the present invention shall result in being clear from the following description and annexed drawings, supplied purely as an explanatory and non limiting example, wherein:

- figure 1 partially indicates, in a schematic view, the dishwashing machine subject of the present invention;
- figure 2 schematically represents a particular of a dishwashing machine according to the known art;
- figure 3 schematically indicates a first particular of the dishwashing machine of figure 1;
- figure 4 schematically represents a second particular of the dishwashing machine of figure 1.

Some of the components of the dishwashing ma-

chine subject of the present invention, that are mentioned in the following, have not been represented in the figures being as that they are relatively simple and in themselves known. With reference to figure 1, the reference number 1 indicates as a whole the structure of the chamber of the dishwashing machine subject of the invention; 2 indicates the actual washing chamber, the walls of which are realised in stainless steel; the frontal face of such chamber 2 is delimited by a door, indicated with 3, which is constituted by an outer shell of painted steel plate and by an inner shell or counter-door, in stainless steel, which faces the interior of the chamber 2.

4 indicates a multifunction device, that as with the known art is provided to the exterior of the washing chamber, equipped with an opening which places in communication the interior of the chamber itself with the interspace between the chamber and the cabinet of the dishwashing machine.

The device 4 carries out known functions, such as the dosage of the regenerating water or the anti-back-flow of water to the water mains, that shall not therefore be described in detail herein (note for example Italian patent N° IT-B-1.238.419). In comparison with similar devices of the known art, the device 4 however, used with the aims of the present invention does have some peculiarities.

Above all the device 4 has within its upper section a mouth 5, in communication with the interior of the washing chamber 2.

According to the known art, a similar opening is to be found in the lower section of the body of the multifunction device and therefore, in substance, about half way up of the overall height of the chamber.

As seen, on the contrary, in the dishwashing machine 1, according to the invention, the mouth 5, which can be appropriately shielded with known techniques, is to be found considerably moved towards the top of the washing chamber.

With an explanatory purpose, figures 2 and 3 respectively illustrate a multifunction device according to the known art and a multifunction device according to the present invention; in figure 2, for simplicity sake, the same reference numbers of figure 3 are used, for indicating similar elements, with the addition of the letter A.

The device according to the known art 4A of figure 2, has a hollow body, equipped with a breather type opening 5A directed towards the interior of the chamber of the machine; such opening has the main function of avoiding the creation of over-pressure/depression within the chamber.

The device 4A further has two outlets, one being in its upper section, indicated with 7A; therefore, the steam in over-pressure is able to exit the washing chamber of the known machines, following a natural path, from bottom to top, from the opening 5A to the outlet 7A, following the path indicated by the arrows 8A.

As shall result in being clear from the following, the opening 5A does not have in itself the effect of allowing

the circulation of air within the chamber; as already mentioned, in fact, in machines of the known type, not equipped with a circulation fan, the steam results in being practically stagnant within the washing chamber, in as that the opening 5A does not have a "draft" effect. As can be seen from figure 3, in the case of the present invention, the mouth 5 is obtained in the upper part of the body of the device 4; an aperture is also provided towards the exterior 7, obtained in the lateral part of the body of the device 4, being lower if compared to the mouth 5.

In the case of the present invention, therefore, a steam/air flow in order to transit within the body 4 has to necessarily follow an unnatural path, from the top towards the bottom; the flow entering the mouth 5 is in fact immediately deviated to 180°, to redescend, and then deviated once again to about 90°, to then exit from the lateral aperture 7, as indicated by the arrow 8 in figure 3.

This has the effect of considerably slowing the flow speed of the air/steam mixture and produces substantial charge losses, which favours the condensation of the steam, that takes place also due to the immediate thermal jump between the temperature of the exiting steam and that of the air present at the exterior of the chamber, in the body 4.

Coming back to figure 1, 9 indicates a hollow body in a plastic material, provided for placing in further communication the external environment with the interior of the chamber 2; said body 9, visible in detail in figure 4, has a breathing mouth 10 of the air present in the interspace between the chamber 2 and the cabinet of the dishwashing machine, and an outlet mouth 11, communicating with the interior of the chamber 2; within the body 9, between the mouth 10 and the mouth 11, at least one deflector is provided 12, having the main purpose of avoiding unwanted water losses from the chamber 2. As is seen, the body 9 has a rounded form, with the aims of favouring a path of the air flow being the most natural possible, whilst compatible with the need of avoiding unwanted water losses from the chamber.

The mouth 11 is directed towards the interior of the chamber 2 in the lower part of the same, at a height being greater than the level that can be reached by the washing water; as is seen the mouth 11 is found in the illustrated case moved towards one of the corners of the chamber 2 defined by the door 3.

13 indicates as a whole a low cost and energy saving heat source that, in the described case, is constituted by a light bulb 14, for instance 25W, inserted in an appropriate lamp fitting 15, to which electrical connection and control means are associated, not represented in the figure for simplicity; the electrical connection means may be constituted for instance by normal wires, while the control means can for instance be constituted by a classical programmer, or timer, of the dishwashing machine.

Naturally, the lamp fitting 15, which in the illustrated case is arranged in the central area of the chamber 2,

is equipped with suitable sealing means, provided for avoiding infiltrations of water or dampness, and the relative risks of short circuiting.

The present invention is based on the following considerations.

In an environment with waterproof walls, such as the washing chamber of a dishwashing machine, having a temperature T being different from the external temperature T<sub>0</sub>, an air pressure is verified on all the points of the walls which tend to exit, if the temperature T is greater than the temperature T<sub>0</sub>.

Generally, realising an opening in any point of a wall and thus placing in communication the interior of the chamber with the exterior, in such point of the chamber a thin layer of air will become established, the so called neutral zone, where the internal and external pressures are balanced. Due to reasons of density differences between the internal and external atmospheres of the washing chamber, and considering that, upon termination of the washing phases, T is always greater than T<sub>0</sub>, the pressures above the neutral zone will be directed from the interior to the exterior of the chamber, and vice versa below such zone.

This is the situation with the actual dishwashing machines and for this reason, as previously mentioned, the normal breathing hole 5A (fig. 3) provided with the known art is not suitable for realising on its own accord, neither the circulation of air within the washing chamber, nor the substantial steam discharge from the chamber.

If on the other hand two apertures are realised within the chamber, being of the same size and resistance, one in the upper part and one in the lower part of the chamber, the neutral zone is found at a medium height between the two apertures and, still considering T is greater than T<sub>0</sub>, a current of air takes place from the exterior to the interior through the lower aperture and from the interior to the exterior through the upper aperture. In practice a "draft" is constituted for the shaft constituted by the mouth 5. In the case of the dishwashing machine, with the purposes of drying, air is introduced to the chamber through the body 9 being of a temperature lower than that present in the chamber itself, full of steam; the latter, as is known, tends to occupy the higher most section of the chamber, therefore it would naturally tend to exit via the upper hole.

In the case of natural ventilation, as in the present invention, where the change of air is obtained by the simple difference between the external temperature and the internal temperature, the position of the neutral zone can be modified respect the layout of the chamber, so as to optimise the capacity of the circulated air, acting on the resistances of the air flow generated by the two apertures; the neutral zone is to be found closer to the aperture that, generally, has the greatest dimensions and/or the less resistance.

In consideration of that described above, therefore, according to the present invention in the washing chamber of the dishwashing machine two mouths are sup-

plied 5 and 10, apt at placing the interior of the chamber 2 with the external environment, the structure of the two mouths 5 and 10 is realised in such a way that they supply appropriate resistance to the incoming and exiting flows, in a way which optimises the capacity of the circulated air. Purely by way of example, the lower mouth 10 could be realised so as to have greater dimensions and/or less resistance to the incoming air if compared to the mouth 5.

The functioning of the dishwashing machine according to the present invention is the following.

Upon termination of a washing phase, i.e. in the moment it is necessary to realise the drying of the dishes, the presence of the mouth 10 determines the entry within the chamber 2, in a natural way, of a flow of air present in the interspace of the cabinet of the machine; the hot air loaded with steam, originating from the wash, tends to raise upwards in the chamber 2.

As said, for reasons due to differences in the densities between the internal and external atmospheres respect the chamber 2, and considering that upon termination of the washing phases the internal temperature  $T$  is always greater than the temperature  $T_0$  (i.e. of the interspace of the cabinet), the pressure above the neutral zones will be directed from the interior to the exterior of the chamber.

In this way, therefore, the natural way of changing the air within the chamber of the dishwashing machine is favoured; the new air incoming from the mouth 10 arranged in the lower part of the chamber 2 will tend to strike the basket or baskets containing the dishes, and to push into the mouth 5 the damp air loaded with steam being present in the upper part of the chamber.

As already indicated, the device 4 is, for this aim, shaped so as to determine a complicated passage for the air/steam mixture to be discharged from the chamber; such complicated passage is furthermore advantageously designed for favouring the condensation of the humidity present in the flow transiting in the device 4.

From the above, it is therefore clear that the dishwashing machine according to the invention results in being equipped with means apt at creating a natural flow of circulated air, such as to generate a thrust on the steam (which, as said, is practically stagnant in the known machines); such flow of air also generates a current of air, apt at realising the dehumidification of the dishes and of the chamber itself. This determines several important advantages:

- the problems of the steam recondensing on the dishes is avoided,
- the drying of the dishes is favoured, which is not only determined by the effect of the temperature, but also due to the passage of fresh air,
- the evaporation of water during the drying period is facilitated,
- the aesthetic appearance of the inner walls of the chamber is improved, which at the end of the drying

phase remain dry, without layers of condensation or drops typical with the known art.

In a preferred form, but not exclusive of the invention, the drying of the dishes can be further improved, by way of a low cost and low powered energy source; in the case being illustrated in fig. 1, this is obtained by way of a light bulb 14, housed in the relative light fitting 15.

In particular, according to the invention, the programming device of the machine provides for the switching on of the light bulb 14 upon termination of the wash.

The switching on of the light bulb 14 has the function however of maintaining the inside of the washing chamber at a certain temperature, so as to improve, or delay, the gradual lowering of such, due to the continuous exiting of hot air.

This has the aim of lengthening, as far as possible, the natural draft effect of the air from the mouth 10, as already described, the greater the temperature difference between the air of the chamber and the environmental air, the greater the capacity of the circulated air.

In this case, therefore the switching on of the light bulb 14 has the effect of maintaining relatively higher over time the difference between the internal temperature of the chamber and the external temperature, in such a way as to further improve the efficiency of the drying phase.

It has been noticed how the dishwashing machine according to the invention allows for obtaining the established aims; in particular, from tests carried out, it has been verified how the drying results of the dishes in accordance with the practically natural ventilation system according to the invention are absolutely satisfactory and better than those of the traditional solutions that do not foresee a forced drying; on the other hand the solution according to the invention is of substantially lower costs if compared to the known solutions that provide a dedicated drying fan.

From the given description the characteristics and advantages of the dishwashing machine subject of the present invention result in being clear.

It is clear that numerous variations can be introduced to the dishwashing machine described as an example, without for this departing from the novelty principles inherent in the inventive idea, as it is also clear that in the practical realisation of the invention the materials and forms of the illustrated particulars can be different, and the same may be substituted with technically similar equivalents.

For instance the two mouths, for the entrance and exiting of the air, do not have to be necessarily realised on two opposite walls of the washing chamber, as illustrated in figure 1. For instance, in an advantageous embodiment of the invention, the mouth 11 described above could be substituted with two breathing mouths, realised in the lower portion of the counter door of the machine.

In accordance with such variations, the air entering the washing chamber reaches a lower temperature if compared with the case described with reference to figure 1, which, due to the reasons explained several times above, causes an advantage of the circulation capacity.

Moreover, in accordance with such variations the positions of the mouths on the counter door in relation to the dishes to be dried is optimum, inasmuch the dishes themselves are arranged laterally with respect to the air flow and the flow directly acts upon the dishes below, with a better circulation.

In such embodiment of the invention two lateral drainage drawings can be provided on the internal shell of the door 3, so as to generate a recirculation of water between the internal shell and the external shell, which cleans the mouths themselves thus freeing them from residues that may be dragged to their rear.

### Claims

1. Dishwashing machine, of the type comprising a washing chamber, characterised in that it provides a ventilation drying system of the dishes being practically natural, i.e. in which a substantial renewal of the air within the washing chamber (2) is induced by the difference between the external temperature and the internal temperature of the chamber (2), said system comprising at least two mouths (5,10) that place the interior of the chamber (2) in communication with the external environment, from among which at least
  - a first mouth (10), which functions as an entry for the fresh air (16) from the exterior of the chamber (2) and is obtained in the lower zone of the chamber (2), and
  - a second mouth (5), that functions as an exit from the chamber (2) for an air/steam flow and is obtained in the upper zone of the chamber (2).
2. Dishwashing machine, according to claim 1, characterised in that said two mouths (5,10) are obtained on different walls of said chamber (2) and that the structure of the two mouths (10,5) are mutually realised in such a way that they offer appropriate resistance against the flows incoming and exiting the chamber (2), the calibration of said resistances being chosen so as to optimise the capacity of the air circulation within the chamber (2).
3. Dishwashing machine, according to claim 1, characterised in that said second mouth (5) is obtained in a multifunction device (4) externally provided respect said chamber (2) and in communication with the same, apt at being passed through by said air/steam flow.

4. Dishwashing machine according to claim 3, characterised in that said second mouth (5) is obtained in the upper part of said multifunction device (4).
5. Dishwashing machine, according to claim 4, characterised in that said multifunction device (4) provides an outlet aperture (7), obtained in the body of said device (4) lower if compared to said second mouth (5).
6. Dishwashing machine, according to claim 3, characterised in that the body of said multifunction device (4) is shaped in such a way that the air/steam flow transiting within the same has to follow an unnatural path (i.e. from top to bottom), with the aim of slowing down the speed of the flow itself and producing substantial charge losses.
7. Dishwashing machine, according to claim 1, characterised in that said first mouth (10) is realised by way of a hollow body (9) equipped with an entry aperture (10) for the fresh air, coming from the exterior of said chamber (2), and an exit aperture (11) of said fresh air to the interior of said chamber (2), said exit aperture realising in particular said first mouth (11).
8. Dishwashing machine, according to claim 1, characterised in that the system further provides for a source of heat (13), being of low energy consumption, that is activated during the drying phase of the dishes, with the aim of improving, or delaying, the gradual temperature drop within said chamber (2) determined by the exiting from the same of said air/steam flow.
9. Dishwashing machine, according to the previous claim, characterised in that said heat source comprises a light bulb (14), housed in a relative light fitting (15), said light fitting being in particular equipped with water and damp tight means, said heat source (13) or light bulb (14) being in particular arranged in the central zone of said chamber (2).
10. Dishwashing machine, according to at least one of the previous claims, characterised in that said first and second mouth (10,5) are obtained on opposite walls of said chamber (2).
11. Dishwashing machine, according to claim 1, characterised in that said first mouth (10) is obtained in the lower internal zone of a door (3) providing entry to said chamber (2), said door (3) having in particular at least one lateral drainage drawing, for generating a recirculation of the water which cleans said mouth of residues that can be dragged to the rear of such.
12. Dishwashing machine, of the type comprising a

washing chamber (2), and a system for air circulation within said chamber (2), characterised in that a heat source (13) is provided being of low energy consumption, such as a light bulb, apt at being activated during the drying phase of the dishes, with the aim of increasing the internal temperature of said chamber (2).

13. Dishwashing machine, according to the previous claim, characterised in that in said chamber (2) the following are obtained:

- a first mouth (10), which functions as an entrance for a flow of fresh air (16) from outside the chamber (2) and is obtained in the lower zone of the chamber (2),
- a second mouth (5), that functions as an exit from the chamber (2) for an air/steam flow (8) and is obtained in the upper zone of the chamber (2).

14. Method for drying dishes in a domestic type dishwashing machine, characterised in that, at least during the drying phase,

- the interior of the washing chamber of the dishwashing machine is placed in communication with the external environment by way of at least two mouths (5,10), so as to induce a renewal of air due to the difference between the external temperature and the internal temperature of the chamber (2),
- a heat source (13) of low energy consumption, such as a light bulb, is activated, with the aim of improving, or delaying, the gradual temperature drop within said chamber (2).

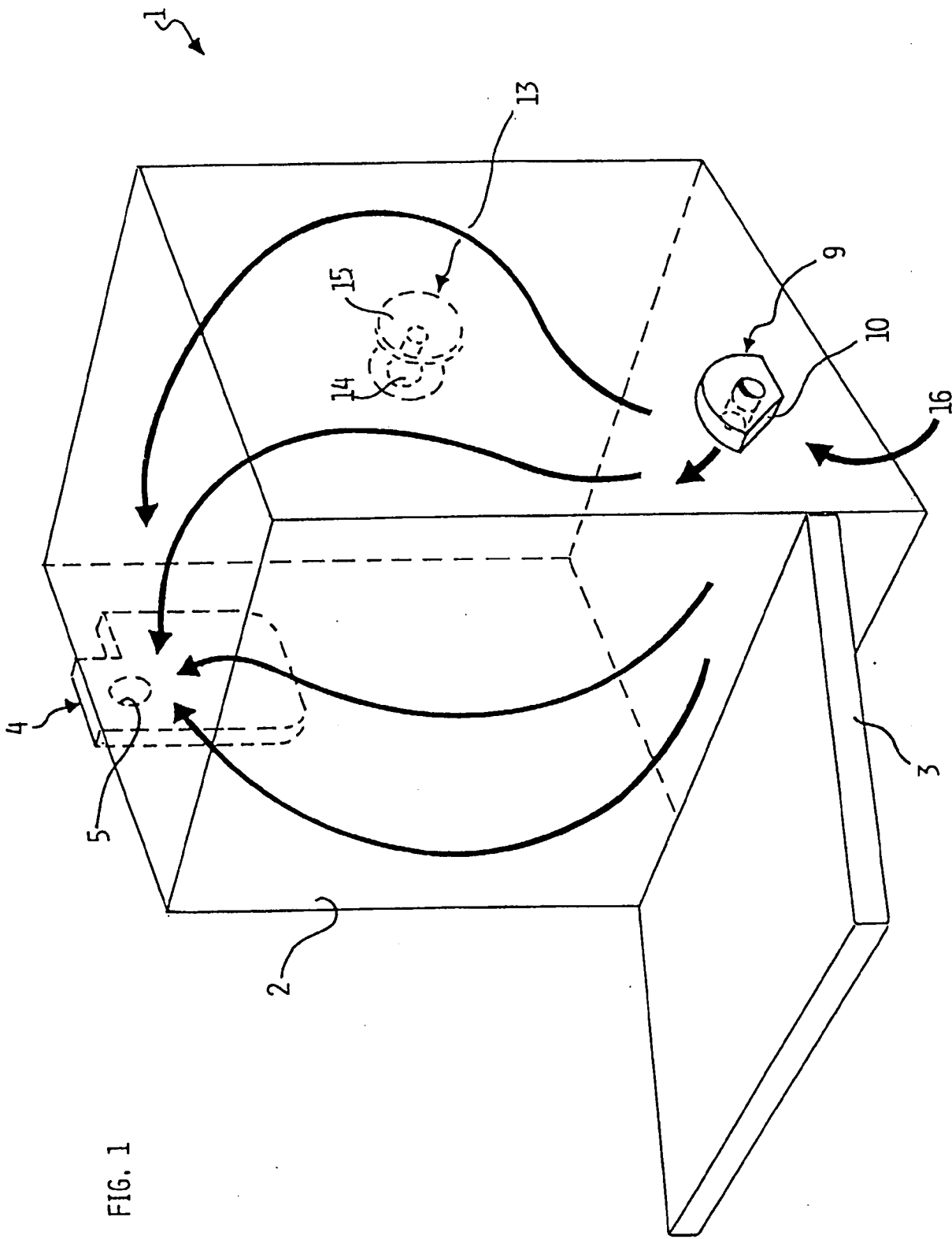
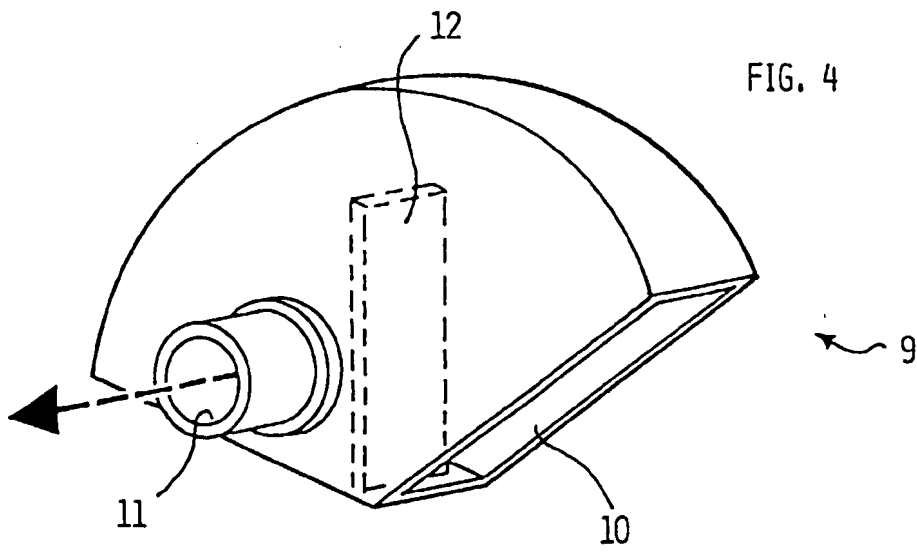
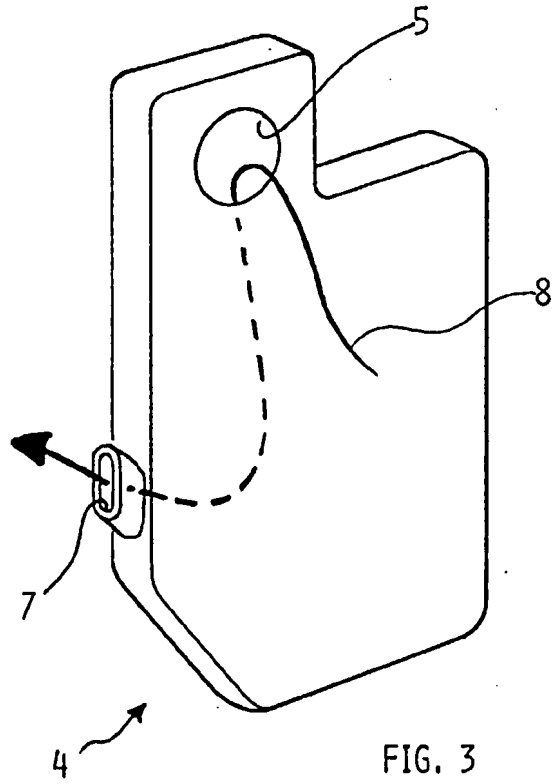
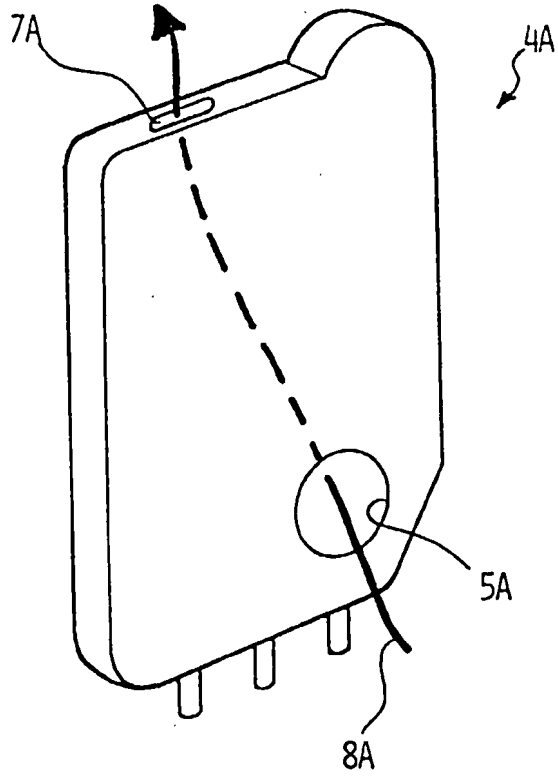


FIG. 1







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# EUROPEAN SEARCH REPORT

Application Number  
EP 96 11 0731

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	CA-A-2 084 688 (ZANUSSI ELETTRODOMESTICI SPA)	1,2	A47L15/48
A	* the whole document *	14	
X	FR-A-2 039 346 (WHIRPOOL CO)	1,8,11,14	
A	* page 1, line 33 - page 3; figures *	3-6	
X	DE-U-66 00 890 (MUELLER & CO KG)	1	
X	FR-A-2 075 918 (INDUSTRIE ZANUSSI SPA)	1	
A	FR-A-2 491 322 (BOSCH-SIEMENS HAUSGERAETE GMBH)	1,2,8,10,12	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			A47L
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 27 September 1996	Examiner Vanmol, M
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